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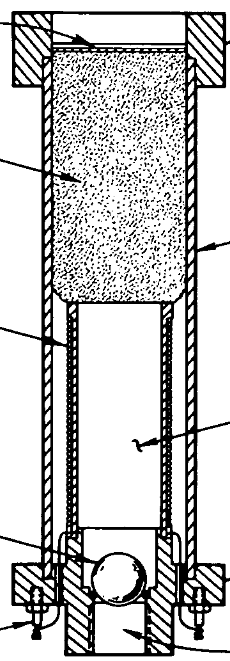
NASA TECH BRIEF

NASA Pasadena Office

Overflow Sensor for Cryogenic-Fluid Vessels

The problem:

To design an overflow sensor for cryogenic-fluid vessels; the sensor must be able to differentiate vapor from liquid at the same temperature.



The solution:

An electrical resistance element which is wound on a porous substrate.

How it's done:

An electrical resistance element is wound on a porous tubular coil form, and the form is positioned in the overflow vent of a cryogenic-fluid vessel. If the voids in the coil form become saturated with overflowing cryogenic liquid, the form is changed from a thermal insulator to a thermal conductor because the thermally insulating gas in the voids is replaced by a more highly conducting fluid. As a result, heat is conducted away from the resistance element. Concomitantly, the resistance of the element changes, and the change in resistance provides the signal that overflowing is occurring. When overflow ceases, the liquefied gas in the voids soon vaporizes and the coil form once again becomes a thermal insulator; the resistance of the element now is the same as before overflow.

The diagram is a vertical cross-section of the sensor. The housing may be made of transparent plastic, glass, or other suitable transparent or translucent material so that heat can radiate into the sensor; exposure of the sensor to ambient room temperature is usually sufficient. The base member provides an inlet which may, for example, be threaded to the upper end of a vent-overflow line. The coil form, supported on the base member, is composed of a porous electrical insulating material, such as cardboard, ceramic, asbestos, etc. The base member is fabricated from electrical insulating material, such as ceramic.

The electrical resistance element may be in the form of a coil of fine copper wire; the ends of the element are brought out through appropriate holes in the base member and connected to the terminals. Packing material serves to retain the coil form in a coaxial position, but its primary purpose is to diffuse liquid globules and cause them to run back into the coil form while allowing the gas to escape. Vented gases from the cryogenic vessel flow into the sensor via the inlet and then through the check valve; the

(continued overleaf)

check valve also directs the liquid content of the first discharge against the inside wall of the coil form and thus accelerates saturation. When a filling cycle is completed, the valve acts as a check valve, preventing any back-streaming of air back into the vessel where it could condense and freeze to form an ice plug.

As an example of the application of the sensor, consider a liquid nitrogen supply connected with the cooling jacket of a cryogenic-fluid storage vessel or the cold trap of a vacuum system. A timer periodically trips a relay which causes a solenoid valve in the conduit to open and replenish the liquid nitrogen in the cooling jacket. The valve remains open until the liquid nitrogen in the jacket overflows into the sensor. The sensor controls a relay which turns off the flow of liquid nitrogen.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 72-10554

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,555,483). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

NASA Patent Counsel
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